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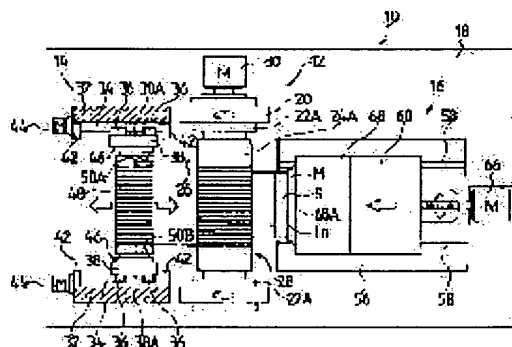
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(54) ENDLESS WIRE SAW ATTACHED WITH STATIONARY ABRASIVE GRAIN

(57)Abstract:

PROBLEM TO BE SOLVED: To secure the length of a wire attached with a stationary abrasive grain and cut a workpiece with high accuracy.

SOLUTION: A stationary abrasive grain attached wire 26 is wound around a groove roller 24A and formed in a wire line 28, while the remainder is wound by an auxiliary roller 48 and formed endless. Thus the stationary abrasive grain attached wire 26 can be used by securing the length and high accuracy cutting can be continued for many hours.



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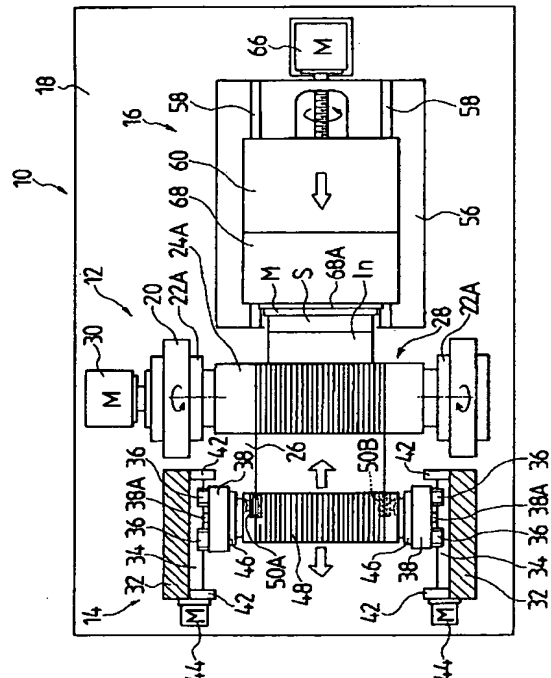
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(54) 【発明の名称】 固定砥粒付エンドレスワイヤソー

(57) 【要約】

【課題】 固定砥粒付ワイヤの長さを確保し、被加工物を精度よく切断することができる固定砥粒付エンドレスワイヤソーの提供。

【解決手段】 固定砥粒付ワイヤ26は、グルーブローラ24A、24Bに巻き掛けられてワイヤ列28を形成するとともに、残余分が補助ローラ48に巻かれて無端状に形成される。これにより、固定砥粒付ワイヤ26の長さを確保して使用することができ、高精度の切断を長時間持続させることができる。



【特許請求の範囲】

【請求項1】 所定間隔をもって配設された複数本のグループローラと、
前記グループローラの近傍に設けられ、周面にらせん状の溝が形成された補助ローラと、
前記複数本のグループローラに巻き掛けられてワイヤ列を形成するとともに、残余分が前記補助ローラに巻かれて無端状に形成される固定砥粒付ワイヤと、
前記複数本のグループローラのうち少なくとも一本のグループローラに連結され、該グループローラを回転させて前記ワイヤ列を走行させるグループローラ回転手段と、
前記グループローラで形成されたワイヤ列と対向するように設けられ、被加工物を保持する被加工物保持手段と、
前記被加工物保持手段を前記ワイヤ列に向けて送り、該ワイヤ列に前記被加工物を押し当てる送り手段と、からなることを特徴とする固定砥粒付エンドレスワイヤソー。

【請求項2】 前記補助ローラは前記グループローラに対して進退移動自在に設けられ、該補助ローラの設置位置を変えることにより前記ワイヤ列に付与する張力を調整することを特徴とする請求項1記載の固定砥粒付エンドレスワイヤソー。

【請求項3】 前記補助ローラの軸線に沿って移動自在に設けられ、前記グループローラに巻き掛けられた固定砥粒付ワイヤを前記補助ローラに導く第1ガイドユニットと、
前記補助ローラの軸線に沿って移動自在に設けられ、前記補助ローラに巻かれた固定砥粒付ワイヤを前記グループローラに導く第2ガイドユニットと、
を備え、前記第1ガイドユニットと第2ガイドユニットの位置を移動させることにより、前記補助ローラに巻き付ける固定砥粒付ワイヤの量を調整することを特徴とする請求項1又は2記載の固定砥粒付エンドレスワイヤソー。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、固定砥粒付エンドレスワイヤソーに係り、特にシリコン、ガラス、セラミック等の硬脆性材料の被加工物を切断する固定砥粒付エンドレスワイヤソーに関する。

【0002】

【従来の技術】シリコン等の硬脆性材料のインゴットからウェーハを切り出す装置の一つに固定砥粒付エンドレスワイヤソーがある。この固定砥粒付エンドレスワイヤソーは、無端状に形成された固定砥粒付ワイヤを複数本のグループローラに巻き掛けてワイヤ列を形成し、そのワイヤ列を高速走行させることにより、ワイヤ列に押し当てられたインゴットを多数枚のウェーハに同時に切断

する装置である。

【0003】ところで、この固定砥粒付エンドレスワイヤソーに使用する固定砥粒付ワイヤは、ワイヤの周面に直接砥粒が固着されているため、切断が進行するにつれて目こぼれや目詰まりが生じ、切れ味が悪化してくるといふ欠点がある。しかし、この欠点は、使用する固定砥粒付ワイヤの長さ（ワイヤ長）を長くすれば解消することができ、従来は、グループローラの長さを長く設定することによりワイヤ長を確保していた。

【0004】

【発明が解決しようとする課題】しかしながら、上記従来の装置では、剛性を確保するためにグループローラが大径となり、構造が大型化するという欠点がある。また、グループローラが大型化することにより慣性重量が増大し、グループローラの駆動部が大型化するという欠点がある。さらに、グループローラは長さが長くなる程、また、径が大きくなる程、加工が困難になり、この結果、設備コストが高くなるとともに、切断精度が低下するという欠点がある。

【0005】本発明は、このような事情に鑑みてなされたもので、固定砥粒付ワイヤの長さを確保し、被加工物を精度よく切断することができる固定砥粒付エンドレスワイヤソーを提供することを目的とする。

【0006】

【課題を解決するための手段】本発明は、前記目的を達成するために、所定間隔をもって配設された複数本のグループローラと、前記グループローラの近傍に設けられ、周面にらせん状の溝が形成された補助ローラと、前記複数本のグループローラに巻き掛けられてワイヤ列を形成するとともに、残余分が前記補助ローラに巻かれて無端状に形成される固定砥粒付ワイヤと、前記複数本のグループローラのうち少なくとも一本のグループローラに連結され、該グループローラを回転させて前記ワイヤ列を走行させるグループローラ回転手段と、前記グループローラで形成されたワイヤ列と対向するように設けられ、被加工物を保持する被加工物保持手段と、前記被加工物保持手段を前記ワイヤ列に向けて送り、該ワイヤ列に前記被加工物を押し当てる送り手段と、からなることを特徴とする。

【0007】本発明によれば、固定砥粒付ワイヤは、グループローラに巻き掛けられてワイヤ列を形成するとともに、残余分が補助ローラに巻かれて無端状に形成される。これにより、使用する固定砥粒付ワイヤの長さを長くして使用することができ、高精度の切断を長時間持続させることができる。また、これにより、ワイヤの寿命が延長する。

【0008】

【発明の実施の形態】以下添付図面に従って本発明に係る固定砥粒付エンドレスワイヤソーの好ましい実施の形態について詳説する。図1、図2は、それぞれ本発明に

係る固定砥粒付エンドレスワイヤソー１０の実施の形態の側面図と平面図である。同図に示すように、固定砥粒付エンドレスワイヤソー１０は、主として、切断ユニット１２、テンションユニット１４及びワーク送りユニット１６から構成されている。

【０００９】まず、切断ユニット１２の構成について説明する。防振台１８ａ、１８ｂ、…を介して水平に設置された架台１８上には、一対のスピンドルブラケット２０、２０が垂直に立設されている。このスピンドルブラケット２０、２０には、左右一組のスピンドルユニット２２Ａ、２２Ｂが上下方向に一対、所定の間隔をもって配設されている。

【００１０】前記一対のスピンドルユニット２２Ａ、２２Ｂには、外周に螺旋状の溝が形成されたグルーブローラ２４Ａ、２４Ｂが回転自在に支持されており、このグルーブローラ２４Ａ、２４Ｂの溝に沿って固定砥粒付ワイヤ２６を巻き掛けてゆくことにより、架台１８に対して垂直なワイヤ列２８が形成される。また、前記一対のグルーブローラ２４Ａ、２４Ｂのうち下側に位置するグルーブローラ２４Ｂには、グルーブローラ駆動モータ３０が連結されており、このグルーブローラ駆動モータ３０を駆動することにより、グルーブローラ２４Ｂが回転する。そして、このグルーブローラ２４Ｂが回転することにより、ワイヤ列２８が走行する。

【００１１】切断ユニット１２は、以上のように構成される。次に、テンションユニット１４の構成について説明する。前記架台１８上には、一対の支持ブラケット３２、３２が垂直に立設されている。この支持ブラケット３２、３２は、それぞれ前記一対のスピンドルブラケット２０、２０に並列して配置されており、それぞれ一対のガイドレール３４、３４が水平に配設されている。このガイドレール３４、３４には、それぞれスライドブロック３６、３６を介して軸受ブラケット３８、３８が摺動自在に支持されている。

【００１２】また、前記一対の支持ブラケット３２、３２には、それぞれガイドレール３４、３４に沿ってネジ棒４０、４０が配設されており、該ネジ棒４０、４０は、それぞれその両端部を軸受部材４２、４２に回転自在に支持されている。前記ネジ棒４０、４０の一方端には、補助ローラ移動用モータ４４、４４の出力軸が連結されており、この補助ローラ移動用モータ４４、４４を駆動することにより、ネジ棒４０、４０が回転する。前記軸受ブラケット３８、３８には、このネジ棒４０、４０と螺合するナット部材３８Ａが固着されており、このネジ棒４０を前記補助ローラ移動用モータ４４、４４で駆動することにより、前記軸受ブラケット３８、３８がガイドレール３４、３４に沿ってスライドする。

【００１３】前記軸受ブラケット３８、３８には、それぞれ軸受ユニット４６、４６が設けられており、該軸受ユニット４６、４６には、補助ローラ４８が回転自在に

支持されている。この補助ローラ４８の周面にはらせん状の溝が形成されており、この溝に沿って前記グルーブローラ２４Ａ、２４Ｂに巻き掛けられた固定砥粒付ワイヤ２６が巻き付けられる。そして、この補助ローラ４８に前記グルーブローラ２４Ａ、２４Ｂに巻き掛けられた固定砥粒付ワイヤ２６が巻き付けられることにより、グルーブローラ２４Ａ、２４Ｂの一方端から他方端に固定砥粒付ワイヤ２６がガイドされる。すなわち、これにより、グルーブローラ２４Ａ、２４Ｂの一方端から他方端に向けて巻き掛けられた固定砥粒付ワイヤ２６が、再び巻き始めの位置であるグルーブローラ２４Ａ、２４Ｂの一方端側にガイドされる。

【００１４】グルーブローラ２４Ａ、２４Ｂの一方端側にガイドされた固定砥粒付ワイヤ２６は、巻き始め側の端部と巻き終わり側の端部を互いにレーザー溶接等で連結されて無端状に形成される。なお、前記グルーブローラ２４Ａ、２４Ｂに巻き掛けられた固定砥粒付ワイヤ２６は、揺動ガイドローラ５０Ａを介して補助ローラ４８に案内される。そして、補助ローラ４８に巻き付けられた固定砥粒付ワイヤ２６は、揺動ガイドローラ５０Ｂを介してグルーブローラ２４Ａ、２４Ｂに案内される。

【００１５】ここで、この揺動ガイドローラ５０Ａ、５０Ｂは、揺動アーム５２Ａ、５２Ｂの先端部に回転自在に支持されており、該揺動アーム５２Ａ、５２Ｂは、その基端部を支持ブラケット３２、３２に揺動自在に支持されている。揺動アーム５２Ａ、５２Ｂの中央部には、前記支持ブラケット３２、３２に揺動自在に支持されたシリンダ５４Ａ、５４Ｂのロッドがピンによって連結されており、このシリンダ５４Ａ、５４Ｂを駆動することにより、揺動アーム５２Ａ、５２Ｂが揺動する。そして、この揺動アーム５２Ａ、５２Ｂが揺動することにより、揺動ガイドローラ５０Ａ、５０Ｂの位置が可変する。

【００１６】テンションユニット１４は、以上のように構成される。そして、前記揺動ガイドローラ５０Ａ、５０Ｂは、その設置位置を調整することにより、固定砥粒付ワイヤ２６の新規巻き掛け時に生じる弛みを除去し、その後固定する。また、補助ローラ４８は、その設置位置を調整することにより、固定砥粒付ワイヤ２６に付与する張力を調整する。

【００１７】なお、前記揺動ガイドローラ５０Ａ、５０Ｂを支持する揺動アーム５２Ａ、５２Ｂには、図示しないロードセルが組み込まれており、このロードセルによって揺動ガイドローラ５０Ａ、５０Ｂに巻き掛けられた固定砥粒付ワイヤ２６の張力が検出される。次に、送りユニット１６の構成について説明する。前記架台１８上には、ベース５６が設置されている。ベース５６上には一対のガイドレール５８、５８が敷設されており、該ガイドレール５８、５８がコラム６０をスライド自在に支持している。

【0018】また、前記ベース56の内部には、ガイドレール58、58に沿ってネジ棒62が配設されており、該ネジ棒62は、その両端部を軸受部材64、64に回動自在に支持されている。前記ネジ棒62の一方端には、架台18上に設けられたワーク送りモータ66の出力軸が連結されており、このワーク送りモータ66を駆動することにより、ネジ棒62が回動する。前記コラム60の下面には、このネジ棒62と螺合するナット部材60Aが固着されており、このネジ棒62を回動させることにより、コラム60がガイドレール58、58に沿って移動する。

【0019】前記コラム60の上部先端には、チルチングユニット68が設けられており、被加工物であるインゴットInは、このチルチングユニット68のワーク保持部68Aに装着される。このチルチングユニット68は、装着されたインゴットInをワイヤ列28に対して水平、垂直方向に所定角度傾斜させて保持し、この傾斜角度を調整することにより、インゴットInの結晶方位合わせを行う。

【0020】なお、このチルチングユニット68へのインゴットInの装着は、マウンティングブロックMを介して行われる。すなわち、スライスペースSを介してインゴットInをマウンティングブロックMに接着し、このマウンティングブロックMをチルチングユニット68のワーク保持部68Aに設けられた図示しないクランプ手段でクランプすることにより装着する。

【0021】次に、前記のごとく構成された本実施の形態の固定砥粒付エンドレスワイヤソー10の作用について説明する。始めに固定砥粒付ワイヤ26の張設方法について説明する。オペレータは、まず、固定砥粒付ワイヤ26の一方端を揺動ガイドローラ50Aにガムテープ等で固定する。この状態で固定砥粒付ワイヤ26をグルーブローラ24A、24Bの方向に引き出し、グルーブローラ24A、24Bの溝に沿って順次巻き掛けてゆく。これにより、垂直なワイヤ列28が形成される。

【0022】ワイヤ列28を形成した固定砥粒付ワイヤ26は、揺動ガイドローラ50Bを介して補助ローラ48に導き、その補助ローラ48に巻き付けてゆく。ここで、この補助ローラ48の外周には、らせん状の溝が形成されているので、この溝に沿って巻き付けることにより、固定砥粒付ワイヤ26は、揺動ガイドローラ50Aに導かれる。

【0023】揺動ガイドローラ50Aに導かれた固定砥粒付ワイヤ26は、その端部同士をレーザー溶接等で連結され、無端状に形成される。そして、この結果、無端状の固定砥粒付ワイヤ26によるワイヤ列28が形成される。ところで、前記のごとく張設されたワイヤ列28には弛みが生じているので、これを除去する必要がある。そこで、オペレータは、前記の張設作業を終了したのち、次いで、シリンダ54A、54Bを駆動すること

により揺動ガイドローラ50A、50Bを揺動させて、固定砥粒付ワイヤ26に生じている弛みを除去する。その後、その位置に揺動ガイドローラ50A、50Bを固定する。なお、この段階においては、固定砥粒付ワイヤ26には溝から外れない程度の張力が与えられればよい。

【0024】前記のごとく固定砥粒付ワイヤ26の弛みを取り除かれると、次にオペレータは、切断に必要な張力の設定を行う。まず、オペレータはグルーブローラ駆動モータ30を駆動してグルーブローラ24Bを回転させ、張設された固定砥粒付ワイヤ26を走行させる。次に、補助ローラ移動用モータ44を駆動して補助ローラ48をグルーブローラ24A、24Bから離れる方向に移動させる。

【0025】ここで、前記のごとく補助ローラ48がグルーブローラ24A、24Bから離れる方向に移動することにより、走行する固定砥粒付ワイヤ26に付与される張力は徐々に高くなっていく。オペレータは、揺動ガイドローラ50A、50Bの揺動アーム52A、52Bに組み込まれているロードセルによって測定される固定砥粒付ワイヤ26の張力が切断に必要な張力となったところで、補助ローラ移動用モータ44の駆動を停止して補助ローラ48の移動を停止するとともに、グルーブローラ駆動モータ30の駆動を停止して固定砥粒付ワイヤ26の走行を停止する。

【0026】なお、ここではオペレータが切断に必要な張力の設定を行っているが、制御手段によって自動で切断に必要な張力を判断し、自動で制御して張力を設定するようにシステムを構成してもよい。以上一連の作業により、固定砥粒付ワイヤ26の張設作業は終了し、これにより、切断に必要な張力に設定されたワイヤ列28が張設される。

【0027】次に、前記のごとくワイヤ列28が張設された固定砥粒付エンドレスワイヤソー10によるインゴットInの切断方法について説明する。まず、オペレータはマウンティングブロックMにスライスペースSを介してインゴットInを接着する。そして、そのマウンティングブロックMに接着されたインゴットInをチルチングユニット68のワーク保持部68Aに装着する。

【0028】次に、オペレータは、インゴットInが所定の結晶方位で切断されるように、チルチングユニット68によってインゴットInをワイヤ列28に対して所定角度傾斜させる。次に、グルーブローラ駆動モータ30を駆動してグルーブローラ24Bを高速回転させ、ワイヤ列28を高速走行させる。なお、この際、固定砥粒付ワイヤ26は無端状に形成されているので、一定の走行路を周回することになる。

【0029】次に、ワーク送りモータ66を駆動して、コラム60を切断ユニット12に向けて一定の送り量で送る。この結果、インゴットInが高速走行するワイヤ

列28に向かって移動し、その走行するワイヤ列28に押し当てられる。ワイヤ列28に押し当てられたインゴットInは、そのワイヤ列28との接触部を固定砥粒付ワイヤ26の周面に固着された固定砥粒に研削され、この結果、多数枚のウェーハに切断される。

【0030】なお、この切断に際して、インゴットInとワイヤ列28との接触部には、その接触部上方に設置された図示しないノズルからクーラントが供給される。供給されたクーラントは、グルーブローラ24Bの下部に設置された図示しないドレンパンで回収され、廃棄される。ところで、本実施の形態の固定砥粒付エンドレスワイヤソー10では、補助ローラ48が設置されていることにより、長さの長いグルーブローラ24A、24Bを使用しなくても、ワイヤ長の長い固定砥粒付ワイヤ26を使用することができる。そして、このようにワイヤ長の長い固定砥粒付ワイヤ26を使用することにより、高精度な切断を長時間持続させることができるとともに、固定砥粒付ワイヤ26の寿命が延長する。

【0031】また、本実施の形態の固定砥粒付エンドレスワイヤソー10では、補助ローラ48をグルーブローラ24A、24Bに対して移動させることにより、切断に必要な張力を容易に設定することができる。なお、本実施の形態では、補助ローラ48を移動させて、その設置位置を調整することにより固定砥粒付ワイヤ26に付与する張力を設定するようにしているが、補助ローラ48は固定とし、揺動ローラ50A、50Bを所定の力（トルク）で揺動させることによって、固定砥粒付ワイヤ26に付与する張力を設定するようにしてもよい。

【0032】また、本実施の形態では、補助ローラ48の長さをグルーブローラ24A、24Bの長さと同じにしているが、補助ローラ48の長さは必要に応じて変えて用いてもよい。また、図3に示すように、グルーブローラ24A、24Bと補助ローラ48との間にガイドユニット70を設置し、このガイドユニット70によって補助ローラ48に巻き付ける固定砥粒付ワイヤ26の巻き付け量を調整するようにしてもよい。このガイドユニット70は、一対の固定ガイドユニット72A、72Bと、一対の可動ガイドユニット74A、74Bとから構成されており、可動ガイドユニット74A、74Bの間隔を調整することにより巻き付け量を調整する。

【0033】前記固定ガイドユニット72A、72Bは、第1ガイドローラ76A、76Bと第2ガイドローラ78A、78Bを有しており、該第1ガイドローラ76A、76Bと第2ガイドローラ78A、78Bは、それぞれ架台18（図示せず）に設置された固定ブロック80A、80B上に設置されている。一方、前記可動ガイドユニット74A、74Bは、第3ガイドローラ82A、82Bと第4ガイドローラ84A、84Bを有しており、該第3ガイドローラ82A、82Bと第4ガイドローラ84A、84Bは、それぞれスライドブロック8

6A、86B上に設置されている。このスライドブロック86A、86Bは、ベース88上に敷設されたガイドレール90、90上をスライド自在に設けられており、図示しないロック手段によってガイドレール90、90上の任意の位置に固定できるように構成されている。

【0034】以上のガイドユニット70を用いて固定砥粒付ワイヤ26の巻き付け量を調整する場合は、巻き付ける固定砥粒付ワイヤ26の長さに応じて、可動ガイドユニット74A、74Bを移動させ、その間隔を調整して固定する。これにより、補助ローラ48を代えることなく任意の長さの固定砥粒付ワイヤ26を巻き付けることができる。

【0035】また、本実施の形態では、補助ローラ48は単に回転自在に支持されているだけであるが、補助ローラ48にモータを連結し、グルーブローラ24A、24Bと同期させて回転してもよい。これにより、補助ローラ48に生じる磨耗を抑制することができる。また、補助ローラ48の磨耗を抑制するために、補助ローラ48の表面を固定砥粒付ワイヤ26の周面に固着された固定砥粒と同程度の硬度を有する材料でコーティングしてもよい。例えば、固定砥粒付ワイヤ26の周面に固着された砥粒がダイヤモンド砥粒であれば、補助ローラ48の表面をダイヤモンドコーティングする。これにより、補助ローラ48の磨耗を有効に防止することができる。

【0036】更に、使用する固定砥粒付ワイヤ26を補助ローラ48の溝形状に合致した異形線ワイヤ（ワイヤの両側部に溝に嵌合するテーパ面を有したワイヤ）を使用し、その上面部にのみ固定砥粒を付着して用いても補助ローラ48の磨耗を有効に防止することができる。

【0037】

【発明の効果】以上説明したように、本発明によれば、切断に使用する固定砥粒付ワイヤの長さを長くして使用することができ、これにより高精度の切断を長時間持続することができる。また、固定砥粒付ワイヤの寿命も延長する。

【図面の簡単な説明】

【図1】固定砥粒付エンドレスワイヤソーの構成を示す側面図

【図2】固定砥粒付エンドレスワイヤソーの構成を示す平面図

【図3】他の実施の形態の固定砥粒付エンドレスワイヤソーの要部の平面図

【符号の説明】

- 10…固定砥粒付エンドレスワイヤソー
- 24A、24B…グルーブローラ
- 26…固定砥粒付ワイヤ
- 28…ワイヤ列
- 30…グルーブローラ駆動モータ
- 44…補助ローラ移動用モータ
- 48…補助ローラ

10

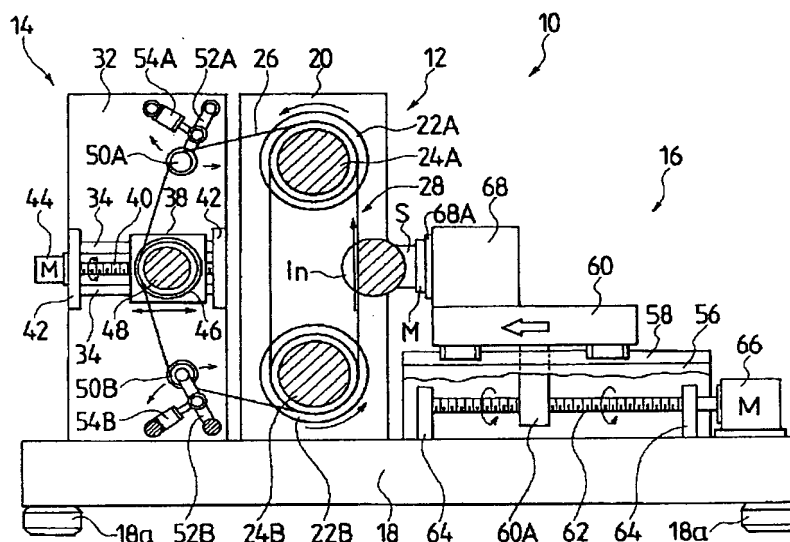
70…ガイドユニット

72A、72B…固定ガイドユニット

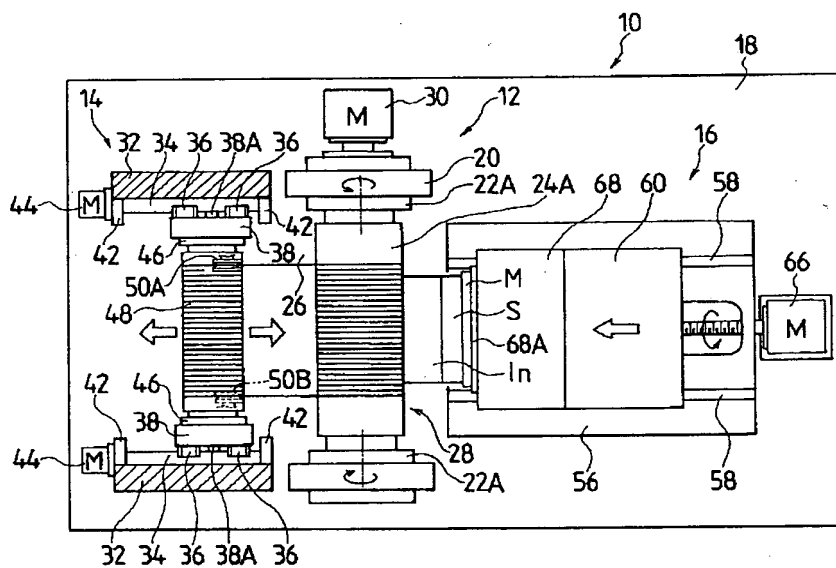
74A、74B…可動ガイドユニット

In…インゴット

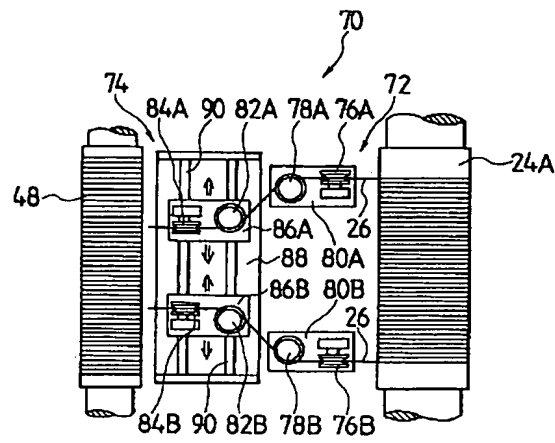
【图 1】



【図 2】



【図 3】



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CLAIMS

[Claim(s)]

[Claim 1] While being almost wound around two or more groove rollers arranged with predetermined spacing, the auxiliary roller with which it was prepared near said groove roller, and the spiral slot was formed in the peripheral surface, and said two or more groove rollers and forming a wire train The wire with bonded abrasive with which a part for the remainder is wound around said auxiliary roller, and is formed in the shape of endless, Said groove roller rotation means for more than one to be connected with at least one groove roller among the groove rollers of a book, to rotate this groove roller, and to make it run said wire train, A workpiece maintenance means to be prepared so that it may counter with the wire train formed with said groove roller, and to hold a workpiece, the delivery means which turns said workpiece maintenance means to said wire train, and presses said workpiece against delivery and this wire train -- since -- the endless wire saw with bonded abrasive characterized by becoming.

[Claim 2] Said auxiliary roller is an endless wire saw according to claim 1 with bonded abrasive characterized by adjusting the tension given to said wire train by being prepared free [attitude migration] to said groove roller, and changing the installation location of this auxiliary roller.

[Claim 3] The 1st guide unit which leads the wire with bonded abrasive which is prepared free [migration] along with the axis of said auxiliary roller, and was almost wound around said groove roller to said auxiliary roller, The 2nd guide unit which leads the wire with bonded abrasive which was prepared free [migration] along with the axis of said auxiliary roller, and was wound around said auxiliary roller to said groove roller, The endless wire saw according to claim 1 or 2 with bonded abrasive characterized by adjusting the amount of the wire with bonded abrasive twisted around said auxiliary roller by moving the location of a preparation, said 1st guide unit, and the 2nd guide unit.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the endless wire saw with bonded abrasive which starts an endless wire saw with bonded abrasive, especially cuts the workpiece of hard and brittle nature ingredients, such as silicon, glass, and a ceramic.

[0002]

[Description of the Prior Art] An endless wire saw with bonded abrasive is in one of the equipment which cuts down a wafer from the ingot of hard and brittle nature ingredients, such as silicon. the ingot pressed against the wire train by this endless wire saw with bonded abrasive winding around two or more groove rollers almost the wire with bonded abrasive formed in the shape of endless, forming a wire train, and carrying out high-speed transit of that wire train -- many -- it is equipment cut to several wafers at coincidence.

[0003] By the way, since the direct abrasive grain has fixed to the peripheral surface of a wire, shedding and blinding arise as cutting advances and the wire with bonded abrasive used for this endless wire saw with bonded abrasive has the fault that sharpness gets worse. However, this fault could be canceled when lengthening the die length (wire length) of the wire with bonded abrasive to be used, and wire length was secured by setting up the die length of a groove roller for a long time conventionally.

[0004]

[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional equipment, in order to secure rigidity, a groove roller serves as a major diameter, and there is a fault that structure is enlarged. Moreover, when a groove roller is enlarged, inertia weight increases and there is a fault that the mechanical component of a groove roller is enlarged. Furthermore, a groove roller has the fault that cutting precision falls while processing becomes difficult, consequently facility cost becomes high, so that die length becomes long, and so that a path becomes large.

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[0005] This invention was made in view of such a situation, secures the die length of a wire with bonded abrasive, and aims at offering the endless wire saw with bonded abrasive which can cut a workpiece with a sufficient precision.

[0006]

[Means for Solving the Problem] Two or more groove rollers arranged by having predetermined spacing in order that this invention might attain said purpose, While being prepared near said groove roller, being almost wound around the auxiliary roller with which the spiral slot was formed in the peripheral surface, and said two or more groove rollers and forming a wire train The wire with bonded abrasive with which a part for the remainder is wound around said auxiliary roller, and is formed in the shape of endless, Said groove roller rotation means for more than one to be connected with at least one groove roller among the groove rollers of a book, to rotate this groove roller, and to make it run said wire train, a workpiece maintenance means to be prepared so that it may counter with the wire train formed with said groove roller, and to hold a workpiece, and the delivery means which turns said workpiece maintenance means to said wire train, and presses said workpiece against delivery and this wire train -- since -- it is characterized by becoming.

[0007] According to this invention, a part for the remainder is wound around an auxiliary roller, and the wire with bonded abrasive is formed in the shape of endless while being almost wound around a groove roller and forming a wire train. The die length of the wire with bonded abrasive to be used can be used by this, lengthening it, and highly precise cutting can be made to maintain for a long time. Moreover, thereby, the life of a wire extends.

[0008]

[Embodiment of the Invention] It explains in full detail about the gestalt of desirable operation of the endless wire saw with bonded abrasive which starts this invention according to an accompanying drawing below. Drawing 1 and drawing 2 are the side elevations and top views of a gestalt of operation of the endless wire saw 10 with bonded abrasive which are applied to this invention, respectively. As shown in this drawing, the endless wire saw 10 with bonded abrasive mainly consists of a cutting unit 12, a tension unit 14, and a work-piece delivery unit 16.

[0009] First, the configuration of the cutting unit 12 is explained. On the vibrationproofing bases 18a and 18a and the stand 18 horizontally installed through --, the spindle brackets 20 and 20 of a pair are set up perpendicularly. The spindle units 22A and 22B of a right-and-left lot are arranged in the vertical direction by these spindle brackets 20 and 20 with a pair and predetermined spacing.

[0010] The groove rollers 24A and 24B with which the spiral slot was formed in the periphery are supported by the spindle units 22A and 22B of said pair free [rotation],

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and the perpendicular wire 26 in 28 is formed in them to a stand 18 by rolling the wire 26 with bonded abrasive almost along the slot of these groove rollers 24A and 24B.

Moreover, the groove roller drive motor 30 is connected with groove roller 24B located in the bottom among the groove rollers 24A and 24B of said pair, and groove roller 24B rotates by driving this groove roller drive motor 30. And when this groove roller 24B rotates, the wire train 28 runs.

[0011] The cutting unit 12 is constituted as mentioned above. Next, the configuration of the tension unit 14 is explained. On said stand 18, the bearing brackets 32 and 32 of a pair are set up perpendicularly. These bearing brackets 32 and 32 are arranged in parallel in the spindle brackets 20 and 20 of said pair, respectively, and are arranged, and the guide rails 34 and 34 of a pair are arranged horizontally, respectively. The bearing brackets 38 and 38 are supported by these guide rails 34 and 34 free [sliding] through slide blocks 36 and 36, respectively.

[0012] Moreover, along with guide rails 34 and 34, the screw rods 40 and 40 are arranged in the bearing brackets 32 and 32 of said pair, respectively, and these screw rods 40 and 40 are supported by the bearing members 42 and 42 free [rotation] in the both ends, respectively. On the other hand, the output shaft of the motors 44 and 44 for auxiliary roller migration is connected with the edge, and the screw rods 40 and 40 rotate by [of said screw rods 40 and 40] driving these motors 44 and 44 for auxiliary roller migration. These screw rods 40 and 40 and nut member 38A to screw have fixed to said bearing brackets 38 and 38, and said bearing brackets 38 and 38 slide to them along with guide rails 34 and 34 by driving this screw rod 40 by said motors 44 and 44 for auxiliary roller migration.

[0013] In said bearing brackets 38 and 38, bearing units 46 and 46 are formed, respectively, and the auxiliary roller 48 is supported free [rotation] at these bearing units 46 and 46. The spiral slot is formed in the peripheral surface of this auxiliary roller 48, and the wire 26 with bonded abrasive almost wound around said groove rollers 24A and 24B along this slot is twisted. And the wire 26 with bonded abrasive is guided to another side edge from the one side edge of the groove rollers 24A and 24B by twisting around this auxiliary roller 48 the wire 26 with bonded abrasive almost wound around said groove rollers 24A and 24B. That is, thereby, the wire 26 with bonded abrasive of the groove rollers 24A and 24B almost rolled towards the another side edge from the edge on the other hand is guided to one side one end of the groove rollers 24A and 24B which are the locations of a cut water again.

[0014] It winds with the edge by the side of a cut water, the edge by the side of an end is mutually connected by laser welding etc., and the wire 26 with bonded abrasive of the groove rollers 24A and 24B guided to one end on the other hand is formed in the shape of endless. In addition, the wire 26 with bonded abrasive almost wound around said groove

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rollers 24A and 24B is guided through rocking guide-idler 50A at the auxiliary roller 48. And the wire 26 with bonded abrasive twisted around the auxiliary roller 48 is guided through rocking guide-idler 50B at the groove rollers 24A and 24B.

[0015] Here, these rocking guide idlers 50A and 50B are supported by the point of swinging arms 52A and 52B free [rotation], and these swinging arms 52A and 52B are supported by bearing brackets 32 and 32 free [rocking] in that end face section. In the center section of the swinging arms 52A and 52B, the rod of the cylinders 54A and 54B supported free [rocking] is connected with said bearing brackets 32 and 32 by the pin, and swinging arms 52A and 52B rock by driving these cylinders 54A and 54B. And when these swinging arms 52A and 52B rock, the location of the rocking guide idlers 50A and 50B carries out adjustable.

[0016] The tension unit 14 is constituted as mentioned above. And by adjusting the installation location, said rocking guide idlers 50A and 50B remove the slack produced at the time of the new volume credit of the wire 26 with bonded abrasive, and fix it after that. Moreover, the auxiliary roller 48 adjusts the tension given to the wire 26 with bonded abrasive by adjusting the installation location.

[0017] In addition, the load cell which is not illustrated is included in the swinging arms 52A and 52B which support said rocking guide idlers 50A and 50B, and the tension of the wire 26 with bonded abrasive almost wound around the rocking guide idlers 50A and 50B by this load cell is detected. Next, the configuration of the delivery unit 16 is explained. The base 56 is installed on said stand 18. On the base 56, the guide rails 58 and 58 of a pair are laid and these guide rails 58 and 58 are supporting the column 60 free [a slide].

[0018] Moreover, the screw rod 62 is arranged in the interior of said base 56 along with guide rails 58 and 58, and this screw rod 62 is supported by the bearing members 64 and 64 free [rotation] in the both ends. On the other hand, the output shaft of the work-piece delivery motor 66 of said screw rod 62 established on the stand 18 in the edge is connected, and the screw rod 62 rotates by driving this work-piece delivery motor 66. This screw rod 62 and nut member 60A to screw have fixed in the inferior surface of tongue of said column 60, and a column 60 moves to it along with guide rails 58 and 58 by rotating this screw rod 62.

[0019] The chill CHINGU unit 68 is formed at the tip of up of said column 60, and work-piece attaching part 68A of this chill CHINGU unit 68 is equipped with the ingot In which is a workpiece. This chill CHINGU unit 68 performs crystal orientation doubling of Ingot In by making level and a perpendicular direction carry out the predetermined include-angle inclination of the ingot In with which it was equipped to the wire train 28, holding, and adjusting whenever [this tilt-angle].

[0020] In addition, wearing of the ingot In to this chill CHINGU unit 68 is performed

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through a mounting block N. That is, Ingot In is pasted up on a mounting block M through a mounting beam S, and it equips by clamping with a clamp means which is not illustrated by which this mounting block M was formed by work-piece attaching part 68A of the chill CHINGU unit 68.

[0021] Next, an operation of the endless wire saw 10 with bonded abrasive of the gestalt of this constituted operation is explained like the above. The set-up approach of the wire 26 with the introduction bonded abrasive is explained. An operator fixes the one side edge of the wire 26 with bonded abrasive to rocking guide-idler 50A with a gummed tape etc. first. The wire 26 with bonded abrasive is pulled out in the direction of the groove rollers 24A and 24B in this condition, and it winds almost one by one along the slot of the groove rollers 24A and 24B. Thereby, the perpendicular wire train 28 is formed.

[0022] The wire 26 with bonded abrasive in which the wire train 28 was formed is led to the auxiliary roller 48 through rocking guide-idler 50B, and is twisted around the auxiliary roller 48. Here, since the spiral slot is formed in the periphery of this auxiliary roller 48, the wire 26 with bonded abrasive is led to rocking guide-idler 50A by twisting along this slot.

[0023] The edges are connected by laser welding etc. and the wire 26 with bonded abrasive led to rocking guide-idler 50A is formed in the shape of endless. And as a result, the wire train 28 with the endless-like wire 26 with bonded abrasive is formed. By the way, since slack has arisen in the wire train 28 stretched like the above, it is necessary to remove this. Then, after an operator ends the aforementioned set-up activity, subsequently, by driving Cylinders 54A and 54B, he makes the rocking guide idlers 50A and 50B rock, and removes the slack produced on the wire 26 with bonded abrasive. Then, the rocking guide idlers 50A and 50B are fixed to the location. In addition, in this phase, the tension of extent from which it does not separate from a slot should just be given to the wire 26 with bonded abrasive.

[0024] If the slack of the wire 26 with bonded abrasive is removed like the above, an operator will set up tension required for cutting next. First, an operator drives the groove roller drive motor 30, rotates groove roller 24B, and makes it run the stretched wire 26 with bonded abrasive. Next, the motor 44 for auxiliary roller migration is driven, and the auxiliary roller 48 is moved in the direction which separates from the groove rollers 24A and 24B.

[0025] Here, the tension given to the wire 26 with bonded abrasive it runs becomes high gradually like the above by moving in the direction in which the auxiliary roller 48 separates from the groove rollers 24A and 24B. An operator stops the drive of the groove roller drive motor 30, and suspends transit of the wire 26 with bonded abrasive while he stops the drive of the motor 44 for auxiliary roller migration and suspends migration of the auxiliary roller 48 in the place where the tension of the wire 26 with bonded abrasive

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measured by the load cell included in the swinging arms 52A and 52B of the rocking guide idlers 50A and 50B turned into tension required for cutting.

[0026] In addition, although the operator is setting up tension required for cutting here, a system may be constituted so that tension required for cutting may be judged automatically, it may control by the control means automatically and tension may be set up. The set-up activity of the wire 26 with bonded abrasive is ended, and the wire train 28 set as tension required for cutting by this is stretched by the activity of an above single string.

[0027] Next, the cutting process of the ingot In by the endless wire saw 10 with bonded abrasive by which the wire train 28 was stretched is explained like the above. First, an operator pastes up Ingot In on a mounting block M through a mounting beam S. And work-piece attaching part 68A of the chill CHINGU unit 68 is equipped with the ingot In pasted up on the mounting block M.

[0028] Next, an operator does the predetermined include-angle inclination of the ingot In to the wire train 28 by the chill CHINGU unit 68 so that Ingot In may be cut by predetermined crystal orientation. Next, the groove roller drive motor 30 is driven, high-speed rotation of the groove roller 24B is carried out, and high-speed transit of the wire train 28 is carried out. In addition, since the wire 26 with bonded abrasive is formed in the shape of endless in this case, a fixed transit way will be gone around.

[0029] Next, the work-piece delivery motor 66 is driven, a column 60 is turned to the cutting unit 12, and it sends with a fixed feed per revolution. Consequently, Ingot In moves toward the wire train 28 which carries out high-speed transit, and is pressed against that wire train 28 it runs. the ingot In pressed against the wire train 28 carries out grinding of the contact section with that wire train 28 to the bonded abrasive which fixed to the peripheral surface of the wire 26 with bonded abrasive -- having -- consequently -- many -- it is cut by several wafers.

[0030] In addition, on the occasion of this cutting, a coolant is supplied to the contact section of Ingot In and the wire train 28 from the nozzle which was installed in that contact section upper part and which is not illustrated. The supplied coolant is collected and discarded with the drain pan which was installed in the lower part of groove roller 24B and which is not illustrated. By the way, in the endless wire saw 10 with bonded abrasive of the gestalt of this operation, even if it does not use the groove rollers 24A and 24B with long die length by installing the auxiliary roller 48, the long wire 26 with bonded abrasive of wire length can be used. And while being able to make highly precise cutting maintain for a long time by using the long wire 26 with bonded abrasive of wire length in this way, the life of the wire 26 with bonded abrasive extends.

[0031] Moreover, in the endless wire saw 10 with bonded abrasive of the gestalt of this operation, tension required for cutting can be easily set up by moving the auxiliary roller

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48 to the groove rollers 24A and 24B. In addition, you may make it set up the tension given to the wire 26 with bonded abrasive with the gestalt of this operation by moving the auxiliary roller 48, considering the auxiliary roller 48 as immobilization and making the rocking rollers 50A and 50B rock by the predetermined force (torque), although he is trying to set up the tension given to the wire 26 with bonded abrasive by adjusting the installation location.

[0032] Moreover, with the gestalt of this operation, although the die length of the auxiliary roller 48 is made the same as the die length of the groove rollers 24A and 24B, the die length of the auxiliary roller 48 may be changed and used if needed. Moreover, the guide unit 70 is installed between the groove rollers 24A and 24B and the auxiliary roller 48, the wire 26 with bonded abrasive twisted around the auxiliary roller 48 by this guide unit 70 twists, and you may make it adjust an amount, as shown in drawing 3. This guide unit 70 consists of fixed guide units 72A and 72B of a pair, and movable guide units 74A and 74B of a pair, is twisted by adjusting spacing of the movable guide units 74A and 74B, and adjusts an amount.

[0033] Said fixed guide units 72A and 72B have the 1st guide idler 76A and 76B and the 2nd guide idler 78A and 78B, and this 1st guide idler 76A and 76B and the 2nd guide idler 78A and 78B are installed on fixed block 80A installed in the stand 18 (not shown), respectively, and 80B. On the other hand, said movable guide units 74A and 74B have the 3rd guide idler 82A and 82B and the 4th guide idler 84A and 84B, and this 3rd guide idler 82A and 82B and the 4th guide idler 84A and 84B are installed on slide-block 86A and 86B, respectively. These slide blocks 86A and 86B are formed for guide-rail [which was laid on the base 88] 90, and 90 top, enabling a free slide, and they are constituted so that it can fix to the location of the arbitration on a guide rail 90 and 90 with the lock means which is not illustrated.

[0034] When the wire 26 with bonded abrasive twists using the above guide unit 70 and it adjusts an amount, according to the die length of the wire 26 with bonded abrasive to twist, the movable guide units 74A and 74B are moved, and the spacing is adjusted and it fixes. Thereby, the wire 26 with bonded abrasive of the die length of arbitration can be twisted, without replacing the auxiliary roller 48 with.

[0035] Moreover, with the gestalt of this operation, although the auxiliary roller 48 is only supported free [rotation], it may connect a motor with the auxiliary roller 48, may be synchronized with the groove rollers 24A and 24B, and may rotate. Thereby, the wear produced on the auxiliary roller 48 can be controlled. Moreover, in order to control wear of the auxiliary roller 48, you may coat with the ingredient which has a degree of hardness comparable as the bonded abrasive which fixed the front face of the auxiliary roller 48 to the peripheral surface of the wire 26 with bonded abrasive. For example, if the abrasive grain which fixed to the peripheral surface of the wire 26 with bonded

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abrasive is a diamond abrasive grain, diamond coating of the front face of the auxiliary roller 48 will be carried out. Thereby, wear of the auxiliary roller 48 can be prevented effectively.

[0036] Furthermore, the variant line wire (wire with the taper side which fits into a slot at the both-sides section of a wire) which agreed the wire 26 with bonded abrasive to be used in the shape of [of the auxiliary roller 48] a quirk is used, and even if it adheres and uses bonded abrasive only for the top-face section, wear of the auxiliary roller 48 can be prevented effectively.

[0037]

[Effect of the Invention] As explained above, according to this invention, the die length of the wire with bonded abrasive used for cutting can be used lengthening it, and, thereby, highly precise cutting can be maintained for a long time. Moreover, the life of a wire with bonded abrasive is also extended.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the endless wire saw with bonded abrasive which starts an endless wire saw with bonded abrasive, especially cuts the workpiece of hard and brittle nature ingredients, such as silicon, glass, and a ceramic.

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PRIOR ART

[Description of the Prior Art] An endless wire saw with bonded abrasive is in one of the equipment which cuts down a wafer from the ingot of hard and brittle nature ingredients, such as silicon. the ingot pressed against the wire train by this endless wire saw with bonded abrasive winding around two or more groove rollers almost the wire with bonded abrasive formed in the shape of endless, forming a wire train, and carrying out high-speed transit of that wire train -- many -- it is equipment cut to several wafers at coincidence.

[0003] By the way, since the direct abrasive grain has fixed to the peripheral surface of a wire, shedding and blinding arise as cutting advances and the wire with bonded abrasive used for this endless wire saw with bonded abrasive has the fault that sharpness gets worse. However, this fault could be canceled when lengthening the die length (wire length) of the wire with bonded abrasive to be used, and wire length was secured by setting up the die length of a groove roller for a long time conventionally.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, the die length of the wire with bonded abrasive used for cutting can be used lengthening it, and, thereby, highly precise cutting can be maintained for a long time. Moreover, the life of a wire with bonded abrasive is also extended.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional equipment, in order to secure rigidity, a groove roller serves as a major diameter, and there is a fault that structure is enlarged. Moreover, when a groove roller is enlarged, inertia weight increases and there is a fault that the mechanical component of a groove roller is enlarged. Furthermore, a groove roller has the fault that cutting precision falls while processing becomes difficult, consequently facility cost becomes high, so that die length becomes long, and so that a path becomes large.

[0005] This invention was made in view of such a situation, secures the die length of a wire with bonded abrasive, and aims at offering the endless wire saw with bonded abrasive which can cut a workpiece with a sufficient precision.

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MEANS

[Means for Solving the Problem] Two or more groove rollers arranged by having predetermined spacing in order that this invention might attain said purpose, While being prepared near said groove roller, being almost wound around the auxiliary roller with which the spiral slot was formed in the peripheral surface, and said two or more groove rollers and forming a wire train The wire with bonded abrasive with which a part for the remainder is wound around said auxiliary roller, and is formed in the shape of endless, Said groove roller rotation means for more than one to be connected with at least one groove roller among the groove rollers of a book, to rotate this groove roller, and to make it run said wire train, a workpiece maintenance means to be prepared so that it may counter with the wire train formed with said groove roller, and to hold a workpiece, and the delivery means which turns said workpiece maintenance means to said wire train, and presses said workpiece against delivery and this wire train -- since -- it is characterized by becoming.

[0007] According to this invention, a part for the remainder is wound around an auxiliary roller, and the wire with bonded abrasive is formed in the shape of endless while being almost wound around a groove roller and forming a wire train. The die length of the wire with bonded abrasive to be used can be used by this, lengthening it, and highly precise cutting can be made to maintain for a long time. Moreover, thereby, the life of a wire extends.

[0008]

[Embodiment of the Invention] It explains in full detail about the gestalt of desirable operation of the endless wire saw with bonded abrasive which starts this invention according to an accompanying drawing below. Drawing 1 and drawing 2 are the side elevations and top views of a gestalt of operation of the endless wire saw 10 with bonded abrasive which are applied to this invention, respectively. As shown in this drawing, the endless wire saw 10 with bonded abrasive mainly consists of a cutting unit 12, a tension

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unit 14, and a work-piece delivery unit 16.

[0009] First, the configuration of the cutting unit 12 is explained. On the vibrationproofing bases 18a and 18a and the stand 18 horizontally installed through --, the spindle brackets 20 and 20 of a pair are set up perpendicularly. The spindle units 22A and 22B of a right-and-left lot are arranged in the vertical direction by these spindle brackets 20 and 20 with a pair and predetermined spacing.

[0010] The groove rollers 24A and 24B with which the spiral slot was formed in the periphery are supported by the spindle units 22A and 22B of said pair free [rotation], and the perpendicular wire train 28 is formed in them to a stand 18 by rolling the wire 26 with bonded abrasive almost along the slot of these groove rollers 24A and 24B.

Moreover, the groove roller drive motor 30 is connected with groove roller 24B located in the bottom among the groove rollers 24A and 24B of said pair, and groove roller 24B rotates by driving this groove roller drive motor 30. And when this groove roller 24B rotates, the wire train 28 runs.

[0011] The cutting unit 12 is constituted as mentioned above. Next, the configuration of the tension unit 14 is explained. On said stand 18, the bearing brackets 32 and 32 of a pair are set up perpendicularly. These bearing brackets 32 and 32 are arranged in parallel in the spindle brackets 20 and 20 of said pair, respectively, and are arranged, and the guide rails 34 and 34 of a pair are arranged horizontally, respectively. The bearing brackets 38 and 38 are supported by these guide rails 34 and 34 free [sliding] through slide blocks 36 and 36, respectively.

[0012] Moreover, along with guide rails 34 and 34, the screw rods 40 and 40 are arranged in the bearing brackets 32 and 32 of said pair, respectively, and these screw rods 40 and 40 are supported by the bearing members 42 and 42 free [rotation] in the both ends, respectively. On the other hand, the output shaft of the motors 44 and 44 for auxiliary roller migration is connected with the edge, and the screw rods 40 and 40 rotate by [of said screw rods 40 and 40] driving these motors 44 and 44 for auxiliary roller migration. These screw rods 40 and 40 and nut member 38A to screw have fixed to said bearing brackets 38 and 38, and said bearing brackets 38 and 38 slide to them along with guide rails 34 and 34 by driving this screw rod 40 by said motors 44 and 44 for auxiliary roller migration.

[0013] In said bearing brackets 38 and 38, bearing units 46 and 46 are formed, respectively, and the auxiliary roller 48 is supported free [rotation] at these bearing units 46 and 46. The spiral slot is formed in the peripheral surface of this auxiliary roller 48, and the wire 26 with bonded abrasive almost wound around said groove rollers 24A and 24B along this slot is twisted. And the wire 26 with bonded abrasive is guided to an another side edge from the one side edge of the groove rollers 24A and 24B by twisting around this auxiliary roller 48 the wire 26 with bonded abrasive almost wound around

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said groove rollers 24A and 24B. That is, thereby, the wire 26 with bonded abrasive of the groove rollers 24A and 24B almost rolled towards the another side edge from the edge on the other hand is guided to one side one end of the groove rollers 24A and 24B which are the locations of a cut water again.

[0014] It winds with the edge by the side of a cut water, the edge by the side of an end is mutually connected by laser welding etc., and the wire 26 with bonded abrasive of the groove rollers 24A and 24B guided to one end on the other hand is formed in the shape of endless. In addition, the wire 26 with bonded abrasive almost wound around said groove rollers 24A and 24B is guided through rocking guide-idler 50A at the auxiliary roller 48. And the wire 26 with bonded abrasive twisted around the auxiliary roller 48 is guided through rocking guide-idler 50B at the groove rollers 24A and 24B.

[0015] Here, these rocking guide idlers 50A and 50B are supported by the point of swinging arms 52A and 52B free [rotation], and these swinging arms 52A and 52B are supported by bearing brackets 32 and 32 free [rocking] in that end face section. In the center section of the swinging arms 52A and 52B, the rod of the cylinders 54A and 54B supported free [rocking] is connected with said bearing brackets 32 and 32 by the pin, and swinging arms 52A and 52B rock by driving these cylinders 54A and 54B. And when these swinging arms 52A and 52B rock, the location of the rocking guide idlers 50A and 50B carries out adjustable.

[0016] The tension unit 14 is constituted as mentioned above. And by adjusting the installation location, said rocking guide idlers 50A and 50B remove the slack produced at the time of the new volume credit of the wire 26 with bonded abrasive, and fix it after that. Moreover, the auxiliary roller 48 adjusts the tension given to the wire 26 with bonded abrasive by adjusting the installation location.

[0017] In addition, the load cell which is not illustrated is included in the swinging arms 52A and 52B which support said rocking guide idlers 50A and 50B, and the tension of the wire 26 with bonded abrasive almost wound around the rocking guide idlers 50A and 50B by this load cell is detected. Next, the configuration of the delivery unit 16 is explained. The base 56 is installed on said stand 18. On the base 56, the guide rails 58 and 58 of a pair are laid and these guide rails 58 and 58 are supporting the column 60 free [a slide].

[0018] Moreover, the screw rod 62 is arranged in the interior of said base 56 along with guide rails 58 and 58, and this screw rod 62 is supported by the bearing members 64 and 64 free [rotation] in the both ends. On the other hand, the output shaft of the work-piece delivery motor 66 of said screw rod 62 established on the stand 18 in the edge is connected, and the screw rod 62 rotates by driving this work-piece delivery motor 66. This screw rod 62 and nut member 60A to screw have fixed in the inferior surface of tongue of said column 60, and a column 60 moves to it along with guide rails 58 and 58

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by rotating this screw rod 60.

[0019] The chill CHINGU unit 68 is formed at the tip of up of said column 60, and work-piece attaching part 68A of this chill CHINGU unit 68 is equipped with the ingot In which is a workpiece. This chill CHINGU unit 68 performs crystal orientation doubling of Ingot In by making level and a perpendicular direction carry out the predetermined include-angle inclination of the ingot In with which it was equipped to the wire train 28, holding, and adjusting whenever [this tilt-angle].

[0020] In addition, wearing of the ingot In to this chill CHINGU unit 68 is performed through a mounting block M. That is, Ingot In is pasted up on a mounting block M through a mounting beam S, and it equips by clamping with a clamp means which is not illustrated by which this mounting block M was formed by work-piece attaching part 68A of the chill CHINGU unit 68.

[0021] Next, an operation of the endless wire saw 10 with bonded abrasive of the gestalt of this constituted operation is explained like the above. The set-up approach of the wire 26 with the introduction bonded abrasive is explained. An operator fixes the one side edge of the wire 26 with bonded abrasive to rocking guide-idler 50A with a gummed tape etc. first. The wire 26 with bonded abrasive is pulled out in the direction of the groove rollers 24A and 24B in this condition, and it winds almost one by one along the slot of the groove rollers 24A and 24B. Thereby, the perpendicular wire train 28 is formed.

[0022] The wire 26 with bonded abrasive in which the wire train 28 was formed is led to the auxiliary roller 48 through rocking guide-idler 50B, and is twisted around the auxiliary roller 48. Here, since the spiral slot is formed in the periphery of this auxiliary roller 48, the wire 26 with bonded abrasive is led to rocking guide-idler 50A by twisting along this slot.

[0023] The edges are connected by laser welding etc. and the wire 26 with bonded abrasive led to rocking guide-idler 50A is formed in the shape of endless. And as a result, the wire train 28 with the endless-like wire 26 with bonded abrasive is formed. By the way, since slack has arisen in the wire train 28 stretched like the above, it is necessary to remove this. Then, after an operator ends the aforementioned set-up activity, subsequently, by driving Cylinders 54A and 54B, he makes the rocking guide idlers 50A and 50B rock, and removes the slack produced on the wire 26 with bonded abrasive. Then, the rocking guide idlers 50A and 50B are fixed to the location. In addition, in this phase, the tension of extent from which it does not separate from a slot should just be given to the wire 26 with bonded abrasive.

[0024] If the slack of the wire 26 with bonded abrasive is removed like the above, an operator will set up tension required for cutting next. First, an operator drives the groove roller drive motor 30, rotates groove roller 24B, and makes it run the stretched wire 26 with bonded abrasive. Next, the motor 44 for auxiliary roller migration is driven, and the

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auxiliary roller 48 is moved in the direction which separates from the groove rollers 24A and 24B.

[0025] Here, the tension given to the wire 26 with bonded abrasive it runs becomes high gradually like the above by moving in the direction in which the auxiliary roller 48 separates from the groove rollers 24A and 24B. An operator stops the drive of the groove roller drive motor 30, and suspends transit of the wire 26 with bonded abrasive while he stops the drive of the motor 44 for auxiliary roller migration and suspends migration of the auxiliary roller 48 in the place where the tension of the wire 26 with bonded abrasive measured by the load cell included in the swinging arms 52A and 52B of the rocking guide idlers 50A and 50B turned into tension required for cutting.

[0026] In addition, although the operator is setting up tension required for cutting here, a system may be constituted so that tension required for cutting may be judged automatically, it may control by the control means automatically and tension may be set up. The set-up activity of the wire 26 with bonded abrasive is ended, and the wire train 28 set as tension required for cutting by this is stretched by the activity of an above single string.

[0027] Next, the cutting process of the ingot In by the endless wire saw 10 with bonded abrasive by which the wire train 28 was stretched is explained like the above. First, an operator pastes up Ingot In on a mounting block M through a mounting beam S. And work-piece attaching part 68A of the chill CHINGU unit 68 is equipped with the ingot In pasted up on the mounting block M.

[0028] Next, an operator does the predetermined include-angle inclination of the ingot In to the wire train 28 by the chill CHINGU unit 68 so that Ingot In may be cut by predetermined crystal orientation. Next, the groove roller drive motor 30 is driven, high-speed rotation of the groove roller 24B is carried out, and high-speed transit of the wire train 28 is carried out. In addition, since the wire 26 with bonded abrasive is formed in the shape of endless in this case, a fixed transit way will be gone around.

[0029] Next, the work-piece delivery motor 66 is driven, a column 60 is turned to the cutting unit 12, and it sends with a fixed feed per revolution. Consequently, Ingot In moves toward the wire train 28 which carries out high-speed transit, and is pressed against that wire train 28 it runs. the ingot In pressed against the wire train 28 carries out grinding of the contact section with that wire train 28 to the bonded abrasive which fixed to the peripheral surface of the wire 26 with bonded abrasive -- having -- consequently -- many -- it is cut by several wafers.

[0030] In addition, on the occasion of this cutting, a coolant is supplied to the contact section of Ingot In and the wire train 28 from the nozzle which was installed in that contact section upper part and which is not illustrated. The supplied coolant is collected and discarded with the drain pan which was installed in the lower part of groove roller

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24B and which is not illustrated. By the way, in the endless wire saw 10 with bonded abrasive of the gestalt of this operation, even if it does not use the groove rollers 24A and 24B with long die length by installing the auxiliary roller 48, the long wire 26 with bonded abrasive of wire length can be used. And while being able to make highly precise cutting maintain for a long time by using the long wire 26 with bonded abrasive of wire length in this way, the life of the wire 26 with bonded abrasive extends.

[0031] Moreover, in the endless wire saw 10 with bonded abrasive of the gestalt of this operation, tension required for cutting can be easily set up by moving the auxiliary roller 48 to the groove rollers 24A and 24B. In addition, you may make it set up the tension given to the wire 26 with bonded abrasive with the gestalt of this operation by moving the auxiliary roller 48, considering the auxiliary roller 48 as immobilization and making the rocking rollers 50A and 50B rock by the predetermined force (torque), although he is trying to set up the tension given to the wire 26 with bonded abrasive by adjusting the installation location.

[0032] Moreover, with the gestalt of this operation, although the die length of the auxiliary roller 48 is made the same as the die length of the groove rollers 24A and 24B, the die length of the auxiliary roller 48 may be changed and used if needed. Moreover, the guide unit 70 is installed between the groove rollers 24A and 24B and the auxiliary roller 48, the wire 26 with bonded abrasive twisted around the auxiliary roller 48 by this guide unit 70 twists, and you may make it adjust an amount, as shown in drawing 3. This guide unit 70 consists of fixed guide units 72A and 72B of a pair, and movable guide units 74A and 74B of a pair, is twisted by adjusting spacing of the movable guide units 74A and 74B, and adjusts an amount.

[0033] Said fixed guide units 72A and 72B have the 1st guide idler 76A and 76B and the 2nd guide idler 78A and 78B, and this 1st guide idler 76A and 76B and the 2nd guide idler 78A and 78B are installed on fixed block 80A installed in the stand 18 (not shown), respectively, and 80B. On the other hand, said movable guide units 74A and 74B have the 3rd guide idler 82A and 82B and the 4th guide idler 84A and 84B, and this 3rd guide idler 82A and 82B and the 4th guide idler 84A and 84B are installed on slide-block 86A and 86B, respectively. These slide blocks 86A and 86B are formed for guide-rail [which was laid on the base 88] 90, and 90 top, enabling a free slide, and they are constituted so that it can fix to the location of the arbitration on a guide rail 90 and 90 with the lock means which is not illustrated.

[0034] When the wire 26 with bonded abrasive twists using the above guide unit 70 and it adjusts an amount, according to the die length of the wire 26 with bonded abrasive to twist, the movable guide units 74A and 74B are moved, and the spacing is adjusted and it fixes. Thereby, the wire 26 with bonded abrasive of the die length of arbitration can be twisted, without replacing the auxiliary roller 48 with.

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[0035] Moreover, with the gist of this operation, although the auxiliary roller 48 is only supported free [rotation], it may connect a motor with the auxiliary roller 48, may be synchronized with the groove rollers 24A and 24B, and may rotate. Thereby, the wear produced on the auxiliary roller 48 can be controlled. Moreover, in order to control wear of the auxiliary roller 48, you may coat with the ingredient which has a degree of hardness comparable as the bonded abrasive which fixed the front face of the auxiliary roller 48 to the peripheral surface of the wire 26 with bonded abrasive. For example, if the abrasive grain which fixed to the peripheral surface of the wire 26 with bonded abrasive is a diamond abrasive grain, diamond coating of the front face of the auxiliary roller 48 will be carried out. Thereby, wear of the auxiliary roller 48 can be prevented effectively.

[0036] Furthermore, the variant line wire (wire with the taper side which fits into a slot at the both-sides section of a wire) which agreed the wire 26 with bonded abrasive to be used in the shape of [of the auxiliary roller 48] a quirk is used, and even if it adheres and uses bonded abrasive only for the top-face section, wear of the auxiliary roller 48 can be prevented effectively.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The side elevation showing the configuration of an endless wire saw with bonded abrasive

[Drawing 2] The top view showing the configuration of an endless wire saw with bonded abrasive

[Drawing 3] The top view of the important section of the endless wire saw with bonded abrasive of the gestalt of other operations

[Description of Notations]

10 -- Endless wire saw with bonded abrasive

24A, 24B -- Groove roller

26 -- Wire with bonded abrasive

28 -- Wire train

30 -- Groove roller drive motor

44 -- Motor for auxiliary roller migration

48 -- Auxiliary roller

50A, 50B -- Rocking guide idler

60 -- Column

66 -- Work-piece delivery motor

68 -- Chill CHINGU unit

70 -- Guide unit

72A, 72B -- Fixed guide unit

74A, 74B -- Movable guide unit

In -- Ingot

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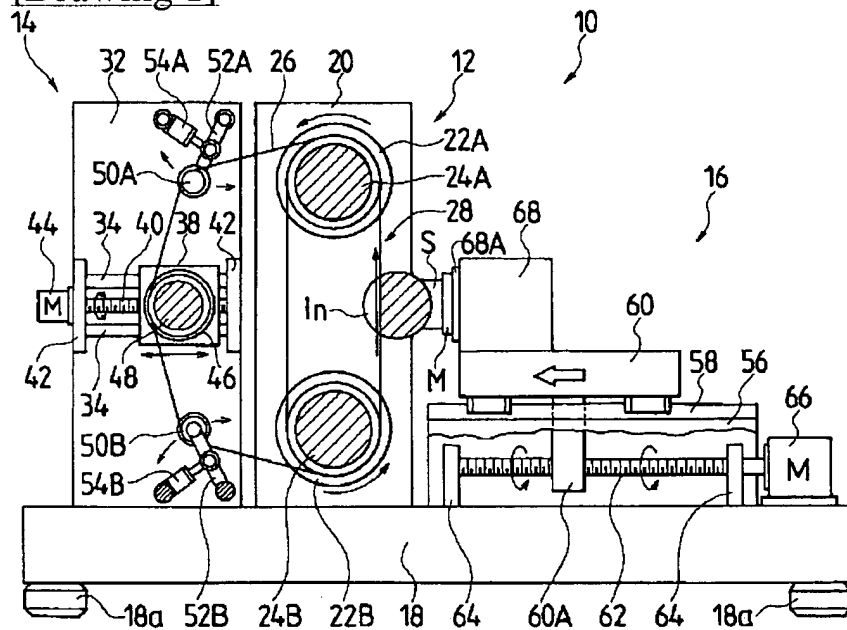
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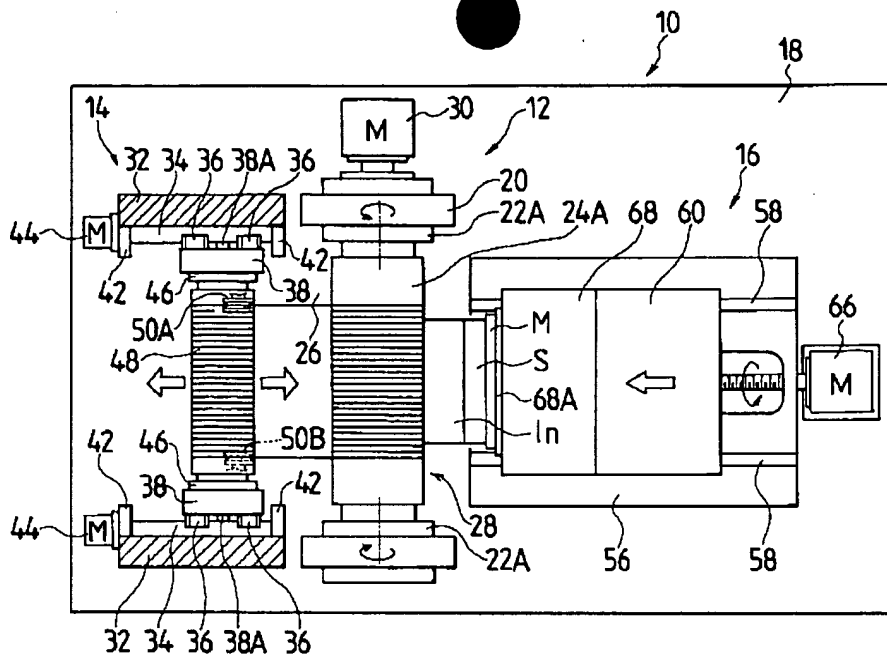
DRAWINGS

[Drawing 1]

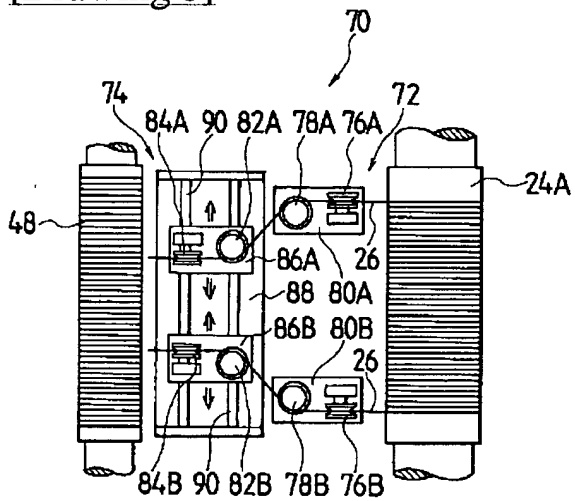


[Drawing 2]

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[Drawing 3]



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